SPECIFICATION

TITLE OF INVENTION: INTERNALLY RESILIENT TIE FOR RAILROAD TRACK

Inventor: Jan H. Zicha Jan H. Zicha

References Cited

U.S. PATENT DOCUMENTS

US-6,364,214 B1	*	6/2000	Sonneville.............................238/115
US-5,203,501	*	04/1986	Vanotti, Gerard.........................238/265
US-4,609,144	*	09/1986	Harmsen, John L.......................238/1
US-4,728,032	*	03/1988	Beigl et al...............................238/382
US-4,616,395	*	10/1986	Farese et al.............................29/460
US-6,027,033	*	02/2000	Vanhonacker, Patric....................238/382
US-2,719,676	*	10/1955	Prater 238/24
US-814,796	*	03/1906	McCallum...............................238/17
US-1,214,339	*	01/1917	McCourt.................................238/91

Jan H. Zicha, Upgrading Track and Roadbed for High Speed Operations, FRA Report DTFR 53 00-P-00377.

FIELD OF INVENTION

The present invention pertains to field of devices for supporting the rails of a railway.

BACKGROUND OF THE INVENTION

Significant and frequently critical part of track loading scenario is the reaction of the track to complex dynamic forces that reflect dynamic excitation of the vehicle that is generated by random irregularities of the track geometry and by variations of track stiffness. However, the conventional track design methods address these issues by time-independent static design approaches only. As a result, analyses of dynamic track/train interaction systems that capture interdependence of track and train components illustrated in Fig. 6 are not usually provided. In reality, dynamic forces from vehicles are not equal to the static reaction of the track as it is typically assumed by the contemporary state of the art in the track design field. The devices invented by Mc Court, H.L.Prater, Harmsen, Vanotti, Beigl, Pratter, Vanhonacker, Farese, and Mc Callum provide constant static resiliency within the ties or on the ties. However, they do not address the actual dynamic response of track structure within the relevant dynamic track/train interaction system. In particular, these and similar devices lack dynamic dampening as the single and most critical dynamic track performance parameter directly related to the longevity of the track structure. Consequently, performance of these systems is incidental in spite of the resiliency they offer. In most of these and similar cases, intense correctional maintenance is necessary so that instances of significant acceptance in railway practice are rare. Only the Sonneville's LVT ballastless track system is dynamically designed and provides extraordinary dampening. Its installations in Euro-tunnel between France and United Kingdom, and on fourteen rapid transit and railroad track systems worldwide provide unprecedented reduction of track maintenance. However, the Sonneville's LVT system is restricted to ballastless track and used exclusively where concrete tunnel inverts and bridge slabs exist to provide firm structural foundation. This restriction simplifies the dynamic track/train interaction system, eliminates

variability of subgrade and foundation soils indicated in Fig. 6 and leads to a specific product named Low Vibration Track (LVT) produced by Permanent Way Corporation and Sonneville International Corporation. Sonneville excludes utilization of LVT system in ballasted track because the potential dynamic instabilities of foundation soils and their variability along the railway line lead to entirely different dynamic loading patterns. The invention of Internally Resilient Tie expands the application of the damper-like arrangement of independent block masses, proven by the Sonneville's LVT system on ballastless track, to the ballasted track category. This is facilitated by further development of the dynamic track/train interaction analyses and specialized software for solving the system shown in Fig. 6 demonstrated in its predecessor form in the referred FRA report DTFR 53 00-P-00377, Jan H. Zicha, Upgrading Track and Roadbed for High Speed Operations, January 30, 2001, and by advanced geotechnical exploration of foundation conditions of the track subgrade in the area of installation Internally Resilient Ties by specialized railway application of remote sensing methods of engineering geophysics.

While the Internally Resilient Ties resemble the devices patented by Mc Court, H.L.Prater, Harmsen, Vanotti, Beigl, Pratter, Vanhonacker, Farese, Mc Callum and Sonneville, they possesses improved properties not sought or expected by prior art. The Internally Resilient Ties are designed to resist actual dynamic loading forces acting in a ballasted track exposed to high speed and heavy axle load operational environments.

Particularly unsuccessful were attempts of prior art to reduce overall track stiffness by the increase of resiliency of the rail pad elastomer located directly under the rail. The rail pad is destroyed quickly by dynamic forces corresponding to high frequency vibrations if made sufficiently soft to be effectual in the reduction of the overall track stiffness. For this reason, hard

rail pads must be used. The nominal stiffness of a ballasted track equipped with standard concrete cross ties is then usually higher than what corresponds to the results of theoretical analyses and to empirical findings. The problem is particularly apparent on bridges and tunnel inverts with ballasted decks where the deterioration of track geometry is particularly intense. Internally Resilient Ties offer sufficient reduction of the nominal track stiffness without compromising hardness of rail pads.

All prior art concrete ties are lifted during the upward deflection of the rail that occurs at a certain distance from applied vertical wheel load. This upward movement is a major contributor to the deterioration of track geometry. This corresponds to the experience with rail float on common wooden ties with cut spikes. Wooden ties with properly installed conventional cut spikes used to secure rail in its position on the tie do not rise because a small space corresponding to the upward deflection of the rail is left between the bottom contact surface of the cut spike's overhang and the upper contact surface of the rail's foot. This space facilitates the rail float, the desired upward movement of the rail without lifting the tie off its contact plane with ballast. Internally resilient ties permit such a movement so that the rail float is no longer restricted to wood ties with cut spikes.

The spread of stray currents and decrease of electrical resistance that is needed for maintaining electrical track circuits appear on any track during rainy weather. Stray currents constitute major liability problems along electrified railway lines due to deterioration of neighboring utilities. While the insulators of track fastening devices are rigorously tested, the leakage occurs mostly through the water layer, dust and steel filings present on the surface of track components. This is because rail support assemblies of prior art do not involve insulators that would create dry areas under their overhangs as it is the case in suspending power

distribution lines. Internally Resilient Ties involve and overhang that creates dry area to interrupt the surface water layer.

Relatively light use of steel ties is attributed to their actual or perceived inadequate electrical insulation characteristics. The enhanced electrical insulation properties of Internally Resilient Ties may contribute to increased utilization of steel ties in the future.

The ballastless track systems that involve large blocks enclosed in rubber boots under the rails, such as the referred LVT system by Sonneville, facilitate large consumption of kinetic energy before it reaches the main vibration-abating insulator. However, the prior art blocks and additional components placed in ties of ballasted track are too light and small to offer comparable enhancement of vibration abatement. The vibrations radiating from heavily traveled lines equipped with ballasted track constitute major environmental problems in large cities regardless of the type of rail support used. The masses of independent blocks used in the Internally Resilient Ties are sufficient to result in the desired reduction of environmentally objectionable vibration spread.